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DIVERSITY AND DISTRIBUTION OF TREE SPECIES USING BIODIVERSITY ASSESSMENT AND MONITORING IN MOUNT LANTOY KEY BIODIVERSITY AREA, ARGAO, CEBU, PHILIPPINES

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ABSTRACT

Mount Lantoy was one of 117 terrestrial areas designated as key biodiversity areas (KBAs) based on vulnerability and irreplaceability criteria. The study aimed to determine the diversity and distribution of tree species in Mount Lantoy Key Biodiversity Area, Argao Cebu, Philippines, using Biodiversity Assessment and Monitoring Systems (BAMS).

The study site recorded a total of 70 species divided into 33 families and 57 genera. Moraceae, Lauraceae, Anacardiaceae, Fabaceae, Sapindaceae, Meliaceae, Primulaceae, Araliaceae, Sapotaceae, and Arecaceae were the most represented families. Ficus, Guoia, Buchanania, Canarium, Dysoxylum, Streblus, Swietenia, Terminalia, Mallotus, Melicope, and Palaquium were the most common genera. Hopea acuminata, Wallaceodendron celebicum, Streblus glaber, Rhus taitensis, Neonauclea calysina, Parishia malabog, Swietenia macrophylla, Parkia javanica, Palaqiuim obovatum, and Buchanania arborescens were the most dominant tree species in terms of importance value.

According to the Shannon diversity index, the diversity and distribution of tree species in Mount Lantoy Key Biodiversity Area (KBA) were relatively low. In the Morisita index, the distribution of tree species was uniform or regular. Cynometra cebuensis Seid (Critically Endangered), Intsia bijuga Colebr (Vulnerable), and Wallaceodendron celebicum Coord are three threatened species. (Vulnerable) according to IUCN 2022-2 and DENR 2017. Illegal cutting, slash and burn cultivation threatened Mount Lantoy, which must be conserved and protected.

KEYWORDS: Key Biodiversity Areas, Diversity, Mount Lantoy, Philippines & Trees

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Original Article

1. INTRODUCTION

Philippines was considered as one of the countries prioritised for conservation because of the degree of damage to biodiversity species as well as to their habitat. Myers et al, (2000) considered the Philippines as one of the 25 megadiversity countries, and also one of the 25 hotspots. Mallari et al. (2001) reiterated that the remaining forest cover of Cebu Island was already less than 1% of its total land area, due to its forest cover loss (Collar et al. 1999).

In the Philippines, the Key Biodiversity Area (KBA) approach was developed to assist the government and stakeholders in prioritizing conservation action and developing geographically specific strategies to protect individual species and representative habitats (Edgar et al. 2008). Strategically targeted site conservation programs can address the root cause of extinction by reducing the loss of natural habitats and the species that depend on them.

The Biodiversity Assessment and Monitoring System (BAMS) is used in accordance with Republic Act (RA) -No. 7586 of 1992, also known as the NIPA Act. The Biodiversity Assessment and Monitoring System was released by the Department of Environment and Natural Resources' Biodiversity Management Bureau on December

22, 2016, as specified in DENR Technical Bulletin No. 2016-05. (DENR-BMB 2016). Furthermore, BAMS could be used to update bio-physical profiles as well as create relevant reports on the state of biodiversity (DENR-BMB, 2016).

Several key organizations conducted initial research in the Mount Lantoy Key Biodiversity Area, focusing on biodiversity species assessment. These organizations include the Academe (CTU Argao Campus), the Cebu Biodiversity Conservation Foundation (CBCF), and the Department of Environment and Natural Resources (DENR) through Flora and Fauna International (FFI), and others (Paguntalan et al., 2008). They reported that KBAs in the southern part of Cebu Island was dominated by plant species such as Palaquium philippinense, Canarium sp., Helicia sp. Rare plant species such as Medinilla albiflora, epiphytic ferns (e.g., Asplenium, Platycerium), and orchids are also mentioned. Climbing bamboo, rattan (Calamus sp.), and thorny vines are overpowering the forest. The substrate is limestone, and the closed-canopy forest is only visible in gullies, with smaller trees covering the ridge top (Panguntalan et al., 2008). However, there is no up-to-date information on the diversity and distribution of tree species in the KBA area.

The Mount Lantoy watershed is threatened by forest land conversion to agricultural areas, human settlements, slash and burn practices, illegal tree cutting for household construction and firewood, and clearing of the area for small-scale mining (Malaki. 2014). Because of these threats and disturbances, there is an urgent need to assess the presence of tree species in the KBA. The study's goal is to update information on the diversity and distribution of tree species in the Mount Lantoy Key Biodiversity Area, which will serve as the foundation for conservation and protection.

2. MATERIALS AND METHODS

2.1. Study Area

Mount Lantoy (9°71.30N, 123°45.3 E) is one of the areas in Cebu's southern region designated as a Key Biodiversity Area. It is situated in the barangay of Tabayag/Cabalawan. It is a part of the Argao-Dalaguete Watershed Forest Reserve, which was established by the Presidential Proclamation (No. 414, 29 June 1994). The Mount Lantoy Key Biodiversity Area has forests over limestone habitat types.

The forest habitat type was comparable to the forest over limestone formation of the Philippines (Fernando et al. 2008) and similar to Whitford's description of the so-called Molave (Vitex parviflora) forest (1911). Less dense vegetation, small trees, and a few large trees dominated the forest. The forest was also overgrown with large outcrop bedrocks, shallow soil, and undecomposed organic matter.

2.2. Establishment of 2-km Permanent Transect

A minimum of 2-kilometer transect line was established along the slope of Mount Lantoy using a meter tape to cover different elevation gradients. While laying out the 2-kilometer transect, each point was marked with highly visible flagging tape every 50 meters.

To distinguish sections from stations, each 250-meter station was marked with a different color flagging tape. The sections were labeled 0a, 0b, 0c, 0d, and 7d, while the stations were labeled 0, 1, 2, 3, and up to 8. The 300m mark was labeled using this calibration. Then, on each of the eight stations, a GPS device was used to mark a point.

2.3. Data Collection

Using the nested quadrat technique, species-level assessments were performed at each 250m station. On the transect line, quadrats were established in alternating directions. Inside the 20m x20m quadrat, measurements of diameter at breast

height (DBH), merchantable height (MH), and total height (TH) were taken for large woody plants with diameters equal to or greater than 10 centimeters. Individual tree flowering and fruiting were also documented. The diameter of the trunk was measured using a diameter tape for larger trees and a tree caliper for smaller trees. The Abney hand level was used to measure the total height and merchantable height.

Identification and counting of small trees less than 10 cm DBH, such as poles, saplings, and shrubs, were performed within the 5m by 5m quadrat. In many cases, the presence of a sufficient number of saplings and young trees in a given population determines the success of regeneration.

During the survey period, all collected plant specimens were dried for long-term storage and systematically processed at the CTU biodiversity herbarium. Relevant literature were consulted, including the Philippine Journal of Science, the Lexicon of Philippine Plants (Rojo et al, 1999), Leaflets of Botany, and CO's Digital Flora of the Philippines (https://www.philippineplants.org).

Specimens were compared to an image database of materials used in the Philippines. Every species encountered in the field was photographed, and identification was done using photographs of fresh plants (https://www.philippineplants.org).

To determine the most abundant species in the site, all tree species were tabulated using scientific names and the corresponding number of individuals per species. To quantify the abundant genera in the area, all of the genera were listed with the corresponding number of individuals per genus. To learn about the abundant families in the KBA, the families were recorded with their corresponding number of individuals per family. All of the tree species in each plot were mapped in order to determine and describe the species' distribution pattern.

2.4. Data Analysis

2.4.1. Diversity of Species

The Shannon, Simpson's, and Evenness indices were calculated using biodiversity software (Past 3 and BioPro Diversity) and data on the number of species and abundance for each sampling quadrat. The Shannon Index estimates species richness and distribution. The evenness index indicates how evenly species or individuals are distributed within a plot or quadrat. Simpson's index calculates the likelihood of encountering two different species when two individuals are drawn (with replacement) inside a plot.

The conservation status of species was based on the most recent recommendations of the Philippine Plant Conservation Committee (PPCC) of the Protected Areas and Wildlife Bureau (PAWB), DENR officially issued as DENR Administrative Order No. 2007-01 now DENR No. 2017-11 known as "The National List of Threatened Philippine Plants and their Categories." The IUCN (IUCN 2022) red list was used as a reference. Some of these ecologically significant species are used as biodiversity indicators for ongoing monitoring.

2.4.2. Importance Value Index

The conservation status of species was based on the most recent recommendations of the Philippine Plant Conservation Committee (PPCC) of the Protected Areas and Wildlife Bureau (PAWB), DENR officially issued as DENR Administrative Order No. 2007-01 now DENR No. 2017-11 known as "The National List of Threatened Philippine Plants and their Categories." The IUCN (IUCN 2022) red list was used as a reference. Some of these ecologically significant species are

used as biodiversity indicators for ongoing monitoring.

The density, relative density, dominance or basal area, relative dominance, frequency, relative frequency, and the Importance Value Index were used to analyze the vegetation (IVI). The following formula was used to calculate the Importance values:

Density = number of individual/area sampled

Relative Density = Density of a species multiplied by the total density of all species multiplied by

100.

Frequency = number of plots where a species occurs divided by total number of plots sampled

Relative Frequency = Species frequency value / Total frequency for all species multiplied by 100

Dominance = a species' basal area or volume/area sampled

Relative Dominance = Species dominance/Total dominance for all species multiplied by 100.

Relative Density + Relative Frequency + Relative Dominance = Importance Value

Each species' ecological importance to the overall forest community was calculated by adding its relative density, relative dominance, and relative frequency (Curtis and Macintosh 1951). These provide a more accurate indicator of a species' importance or function in its habitat than density alone. In addition, the I.V. can also be used in place of density alone to calculate the plot's Shannon diversity and evenness indices.

3. RESULTS AND DISCUSSIONS

3.1. Characteristics of the Study Sites

Mount Lantoy's Plot 1 (0954.092 N, 123 31.793 E) was discovered. The area has a topography that is classified as Mountainous and has an elevation of 406m. The Plot is 70 percent vegetated, 80 percent canopy cover, and 40 percent understory cover. This implies that this plot was dominated by tree species with diameters ranging from 10 to 30 cm, as well as a few understory species. Larger trees could create an area close to the canopy and reduce the penetration of solar energy from the sun, resulting in fewer species regeneration.

Plot 2 (0954.198 N, 123 31.824 E) was discovered at the base of Mount Lantoy, at an elevation of 376m. The plot is shaded by a greater number of larger trees. The majority of these large trees have a diameter ranging from 11 to 41cm. The plot has a vegetation cover of 60%, a canopy cover of 70%, and a 50% understory cover. The plot was found to be more stratified than the other plots. The large number of small-sized trees in the plot indicates that more light intensity is infiltrating.

Plot 3 (9.90293 N, 123.53196 E) is located in Mount Lantoy and has a mountainous topography with elevations ranging from 455m. The area was densely forested, with trees ranging in size from small to large. The diameter of the tree ranges from 11 to 40cm. The site has a vegetation cover of 50%, an 80 percent canopy cover, and a 30% understory. The plot as a whole has a closed canopy cover, which allows less solar radiation to penetrate the ground surface. The plot is also covered by outcrop boulders, accounting for approximately 80% of the site.

Plot 4 (9.90368 N, 123.53436 E) was discovered in Mount Lantoy with an elevation range of 511m. and mountainous topography. The site was covered by smaller trees ranging in size from 11 to 30cm. The plot has a vegetation cover of 60%, a canopy cover of 70%, and a 50% understory cover. In comparison to other plots, the plot was almost uniform in height and was not stratified. The presence of a large number of small-sized trees on the site indicates that more light intensity will be absorbed.

Plot 5 (9.90399 N, 123.53668 E) was discovered in Mount Lantoy with an elevation range of 524m. and mountainous topography. The site was covered by smaller trees ranging in size from 11 to 30cm. The plot has a vegetation cover of 60%, a canopy cover of 70%, and a 50% understory cover. In comparison to other plots, the plot was almost uniform in height and was not stratified. The presence of a large number of small-sized trees on the site indicates that more light intensity will be absorbed.

Plot 6 (09'54.296 N, 123' 32.195 E) was discovered in Tabayag with an elevation range of 575m. and mountainous topography. The site was covered by smaller trees ranging in size from 11 to 30cm. The plot has a vegetation cover of 60%, a canopy cover of 70%, and a 50% understory cover. In comparison to other plots, the plot was almost uniform in height and was not stratified. The presence of a large number of small-sized trees on the site indicates that more light intensity will be absorbed.

Plot 7 (09'54.204 N, 123'32.334 E) was discovered in Tabayag with an elevation range of 483m. and mountainous topography. The site was covered by smaller trees ranging in size from 11 to 30cm. The plot has a vegetation cover of 60%, a canopy cover of 70%, and a 50% understory cover. In comparison to other plots, the plot was almost uniform in height and was not stratified. The presence of a large number of small-sized trees on the site indicates that more light intensity will be absorbed.

Plot 8 (09'54.161 N, 123'32.468 E) was discovered in Tabayag with an elevation range of 485m. and mountainous topography. The site was covered by smaller trees ranging in size from 11 to 30cm. The plot has a vegetation cover of 60%, a canopy cover of 70%, and a 50% understory cover. In comparison to other plots, the plot was almost uniform in height and was not stratified. The presence of a large number of small-sized trees on the site indicates that more light intensity will be absorbed.

Plot 9 (09'54.188 N, 123'32.943 E) was discovered in Catang with an elevation range of 103m. and mountainous topography. The site was covered by smaller trees ranging in size from 11 to 30cm. The plot has a vegetation cover of 60%, a canopy cover of 70%, and a 50% understory cover. In comparison to other plots, the plot was almost uniform in height and was not stratified. The presence of a large number of small-sized trees on the site indicates that more light intensity will be absorbed.

3.2. Species Composition

The KBA site recorded a total of 255 individuals, 58 species, 28 families, and 41 genera. The species Mallotus philippensis (Lam.) Mull, dominated the site. Arg., Rhus taitensis Guill, Buchanania arborescens (Blume) Blume, Cratoxylum sumatranum (Jack) Blume, Pittosporum pentandrum (Blume) Merr, Swietenia macrophylla King, Gmelina arborea Roxb, and Guioa sp.Litsea, Mallotus, and Polyscias were the most common genera, while the most common families were Meliaceae, Fabaceae, Araliaceae, Lauraceae, Sapindaceae, Anacardiaceae, Moraceae, Arecaceae, Primulaceae, Annonaceae, Lamiaceae, and Euphobiaceae. All of the dominant species were classified as small trees because they were

either pioneer species or belonged to a secondary growth forest (Rojo et al., 1999). The findings imply that Mount Lantoy was covered or dominated by small tree species, or that it was classified as secondary forest (Rojo et al., 1999).

3.3. The Spatial Distribution of the Tree Species

The Morisita index was used to evaluate the spatial distribution of species at the study site. Individuals of the same species in the same geographic area have different spatial arrangements of uniformity. The Morisita index equation was used in this study to define the spatial distribution of the tree species. The Morisita has two variables: total plot count and number of individuals per plot. When the Morisita index is equal to one, the pattern of spatial arrangement of the tree species is random; aggregate when the index is greater than one; and uniform or regular when it is less than one.

In this study, the computed Morisita index for each species was less than one. Species' spatial distribution was classified as uniform or regular. When there is strong competition between individuals or when there is a positive antagonism that encourages uniform spacing, the distribution of a given population is said to be regular or uniform.

This study documented some critically endangered species, such as Cynometra cebeunsis Seidenschawarz. According to IUCN (2017), DENR (2017), and endemic in Cebu, the species is critically endangered. Instia bijuga (Colebr.) Kuntze was classified as Less Concerned by the IUCN (2017), but it was classified as Vulnerable by the DENR red list (2017). Wallaceodendron celebicum Koord was classified as Less Concern by the IUCN (2017) but as Vulnerable by the DENR (2017).

3.4. Diversity of Tree Species

Mount Lantoy KBA has a computed species diversity value of H'=2.40 for the Shannon index of diversity in this study (Figure 1). The result of the Shannon index estimation of species diversity indicates that species diversity in Mount Lantoy was relatively low (MacDonald 2003). The Simpson index of diversity indicates that the diversity of species on Mount Lantoy was very high. The Shannon-Weiner index value rises as biodiversity species increase. While the Simpson index measures species relative abundance, a higher value indicates high dominance and low biodiversity (Lillo 2019).

Diversity is a community characteristic associated with stability, productivity, and trophic structure (McIntosh 1967; McNaughton 1977; Tilman 1996), as well as migration (Wisheu and Keddy 1996; Caley and Schluter 1997; Colwell and Lees 2000). A low species diversity area results in an unstable and unproductive ecosystem.

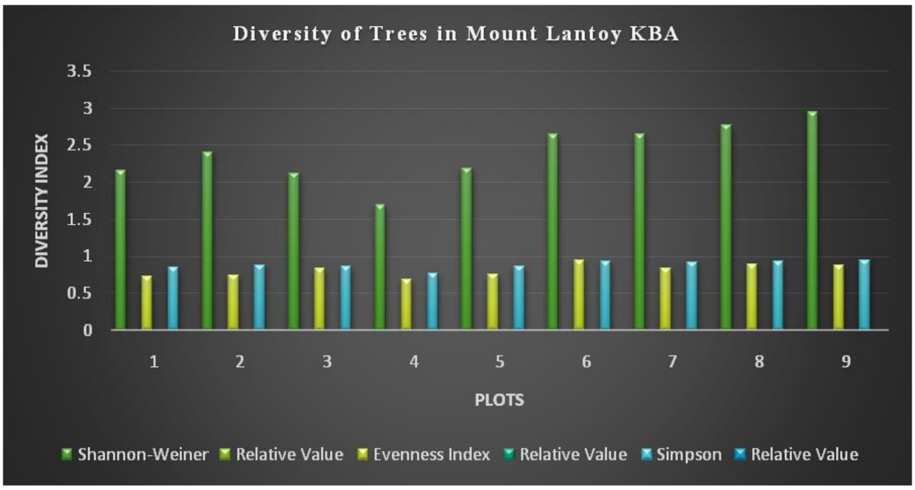

Figure 1: Diversity of Tree Species in Mount Lantoy KBA.

3.5. Relative Frequency, Density, Dominance, and Importance Value

According to the computation, the most abundant species in the Mount Lantoy KBA were Mallotus philippensis (Lam.) Mull. Buchanania arborescens (Blume) Blume, Rhus taitensis Guill., Cratoxylum sumatarnum (Jack) Blume, Swietenia macrophylla King, Gmelina arborea Roxb., and Guioa sp. (See Table 1). The species considered to be the most dominant in terms of frequency and diameter based on observation and record.

The species' distribution was discovered in all four corners of the KBA's established plots. The species' wildlings and saplings were scattered on the Mount Lantoy KBA forest floor. In the conservation of Mount Lantoy KBA, dominant native trees play an important role as priority species for reforestation and rehabilitation in the area, because they were adapted to the environment (Lantican, 2015).

Table 1: The Relative Frequency, Relative Dominance, Relative Density and Importance value (I.V.) of Tree Species in Mount Lantoy KBA

Scientific Name	Relative Frequency		Relative Dominance	Relative Density	I.V
Mallotus philippensis (Lam.) Mull. Arg.	0.02		0.40	0.05	46.46
Wallaceodendron celebicum Koord.	0.12		0.36	0.04	40.81
Buchanania arborescens (Blume) Blume	0.05		0.20	0.05	30.60
Rhus taitensis Guill.	0.11		0.10	0.06	26.61
Cratoxylum sumatranum (Jack) Blume	0.07		0.16	0.33	25.61
Swietenia macrophylla King	0.04		0.17	0.03	24.96
Gmelina arborea Roxb.	0.02		0.20	0.02	24.66
Guioa sp.	0.054		0.13	0.05	23.31

4. CONCLUSIONS

The Mount Lantoy Key Biodiversity Area (KBA) had a low diversity and distribution of tree species. The implication of this finding was that, despite the mountain's designation as a KBA, its floral diversity deteriorated over time as a result of human intervention in the area. Threats and disturbances were attributed to local community/people settlements, illegal cutting of trees for household construction and firewood, slash and burn practices, and clearcutting of small-scale mining areas.

The KBA site recorded a total of 255 individuals, 58 species, 28 families, and 41 genera.

Mallotus philippensis (Lam.) Mull. was the tree species with the highest importance value. Buchanania arborescens (Blume) Blume, Rhus taitensis Guill, Cratoxylum sumatranum (Jack) Blume, Swietenia macrophylla King, Gmelina arborea Roxb, and Guioa sp. Mallotus philippensis (Lam.) Mull. dominated the Mount Lantoy KBA. Arg. It has the highest importance value index (46.46%).

In the Morisita index, the distribution of tree species was uniform or regular. According to DENR Administrative Order No. 2017-11, this study recorded three threatened species: Cynometra cebeunsis Seidenschawarz.F, Instia bijuga (Colebr.) Kuntze, and Wallaceodendron celebicum Koord.

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